InSAR monitoring of slope movements in Gisborne, New Zealand

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* **This abstract is for an Oral**
* **GIS/Remote Sensing of Connectivity and Geomorphic Change**
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# ABSTRACT

# In New Zealand, land surface changes resulting from human activities have emerged as a factor of equal, if not greater importance than climate change, in affecting landslide occurrence. Gisborne is a remote city on the northeast North Island of New Zealand, close to the Hikurangi Subduction Zone. The area is vulnerable to natural hazards, such as tsunami, earthquakes, coastal erosion, flooding, and particularly landslides. Vulnerability is also characterized by a range of social, economic, and infrastructural issues which uniquely culminate in Gisborne. Gisborne has the highest percentage of indigenous Māori people for a New Zealand city and experiences a high degree of socioeconomic disadvantage. The city is remote from other urban centers, taking >3 hours to reach the nearest adjacent city via rural roads that are vulnerable to closure during and following natural hazard events. In particular, landslide risk in recent years has been exacerbated by urban and suburban expansion of residential development into sub-optimal terrain, on steep hill slopes surrounding the city. The hills are underlain by weak Neogene sediments and uplifted Pleistocene estuarine deposits. Gisborne District Council has previously attempted to delineate landslide risk areas but has been hampered by the lack of detailed empirical data. Based on observational data from Sentinel-1 imagery, this study used interferometric synthetic aperture radar (InSAR) to reveal the pattern of slope deformation across Gisborne’s steepland periphery from January 2016 to December 2021 (Cook et al., 2022a,b; 2023). Velocities in the line of sight were obtained from the stack of interferograms and projected along the direction of maximum slope, to extract the true displacement on the slopes. The ascending and descending data sets were combined to reveal the vertical and horizontal components of the deformation. The results were combined with a regional LiDAR dataset, aerial imagery and field observations to delineate areas of slope deformation. Finally, slope deformation time series data was compared with rainfall records to identify seasonal changes, as well as shrink/swell of expansive soils. Results identified 132 unstable slopes within the study area, affected by soil creep, slumping and earthflows. Despite clear evidence of the effects of tree removal, loading of slopes by construction activity, and installation of unconsented, inadequate retaining walls contributing to slope failure, such activities unfortunately continue to occur.

# REFERENCES

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